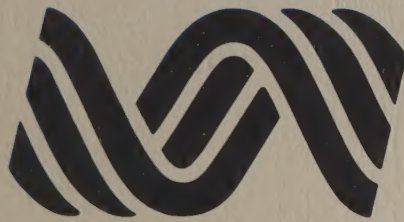


INSTRUCTION MANUAL
IMC1

Monitor

Bill MANSON



**California
INSTRUMENTS**

MP MASTER



MA28098

Invertron[®] AC POWER EQUIPMENT

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IMC1 POWER MONITOR

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SECTION I

1.1 INTRODUCTION

This instruction manual contains information on installation, operation and maintenance of the IMC1 Power Monitor used in California Instruments XP-series AC power sources.

1.2 DESCRIPTION

The IMC1 Power Monitor is a plug-in unit designed for use with the XP Series AC Power Sources. The front panel of the monitor contains a digital LED display that reads out Volts, Amps or kiloWatts. Additionally, the front panel contains a separate overtemperature LED and a separate overload indicator LED. The range key located on the front panel is used to change the output range of the power source. Output range may also be remotely changed through the oscillator/AC power controller.

Any one of the three digital LED displays may be selected either locally using the front panel keys or remotely selected through the oscillator/AC power controller.

1.3 SPECIFICATIONS

Operating specifications for the IMC1 Power Monitor are shown in Table 1-1.

TABLE 1-1 SPECIFICATIONS

IMC1 POWER MONITOR

ACCURACY:	±1 digit from 45 Hz to 5 KHz ±2 digits from 45 Hz to 10 KHz
FUNCTIONAL OPTIONS:	"Volts", "Amps", "kiloWatts".
RESOLUTION:	1 volt for "Volts", 0.1 amp for "Amps", 10 watts for "kiloWatts".
METER:	3 1/2 digit LED display
FREQUENCY RESPONSE:	±1 digit from 45 Hz to 5 KHz ±2 digits from 45 Hz to 10 KHz
TEMPERATURE COEFFICIENT:	0.01% of full scale per degree C for "Volts". 0.016% of full scale per degree C for "Amps". 0.06% of full scale per degree C for "kiloWatts".

SECTION II INSTALLATION

2.1 GENERAL

This section describes unpacking and installation requirements for the IMC1 Power Monitor.

2.2 UNPACKING

The IMC1 Power Monitor is shipped in a corrugated carton and supported within the carton by protective, cushioning material. If the carton has been damaged during transit, conduct a detailed inspection to determine if the monitor has also been damaged. If damage is in evidence, notify the carrier's agent immediately. Retain the monitor and the shipping carton in the same condition as received until it has been examined by the carrier's representative.

2.3 POWER REQUIREMENTS

The IMC1 Power Monitor requires ± 18 volts DC and +5 volts DC inputs. The ± 18 volts DC are regulated to ± 15 volts DC at 36 mA. The -15 volts DC is regulated to -5 volts DC at 100 μ A. The ± 15 volts and -5 volts DC supplies are for powering the analog circuitry. The +5 volts DC is required for powering the digital circuitry.

CAUTION

Voltages up to 270 volts AC are present inside Power Sources. This equipment uses potentially lethal voltages

DEATH

On contact may result if safety precautions are not observed. Do not touch any of the internal circuits when power is applied.

2.4 INSTALLATION

CAUTION

REMOVE POWER FROM THE POWER SOURCE BEFORE
INSTALLING OR REMOVING THE POWER MONITOR.

The IMC1 Power Monitor is designed to mount in the front panel opening of the XP-Series AC power source. Note the ribbon cable coming from the motherboard of AC power source. Carefully plug the external cable into the main connector on the monitor. Place the monitor in position over the opening and fasten its two captive screws.

2.5 POWER SOURCE INTERCONNECTION

IMC1 Power Monitor is used in single-phase XP-series AC power sources. Three single-phase power sources together make a three-phase system. Oscillator output is available at J7 pin 8. This signal goes through the amplitude control gainpot in the Power Monitor and the AC signal at the gainpot wiper or the input to the preamplifier of the power source is available at J7 pin 16. For three-phase system connect J7 pin 2 of phases B and C units to J7 pins 24 and 28 of Phase A unit respectively. Use the interface cable assembly 4000-427 for interfacing the three power sources together. Figure 2-1 illustrates the connections for the polyphase system.

2.6 ACCEPTANCE TEST PROCEDURE

- 1) Turn on the associated XP-Series power source. Verify that the "Volts" annunciator is illuminated and the range annunciator is off indicating low range at the output.
- 2) Set the frequency to 400 Hz.
- 3) With low signal at oscillator output (0 to 0.35 volts rms), verify that the output range level can be changed by pressing the range key. The range LED is illuminated at high range. Increase the oscillator signal to more than 0.35 volts rms and press the range key. Verify that the range changing is locked out.
- 4) Set the output of the power source to 10 volts rms. Display should read 010.
- 5) Set the output of the power source to 270 volts rms. Display should read 270.
- 6) Press the "Amps" key. Set the output to 10% of the rated output by applying proper load to the output of the power source. Display should read the current value ± 1 digit.
- 7) Apply proper load to the output for full rated current. Display should read the current value ± 1 digit.
- 8) Press the "kiloWatts" key. Set the output voltage to 10V and output current to 10% of rated output. Display should read the output kiloWatts ($V \times I/1000$) ± 1 digit.
- 9) Set the output voltage to 270 volts rms and output current to full scale. Display should read the full rated output kiloWatts ($V \times I/1000$).

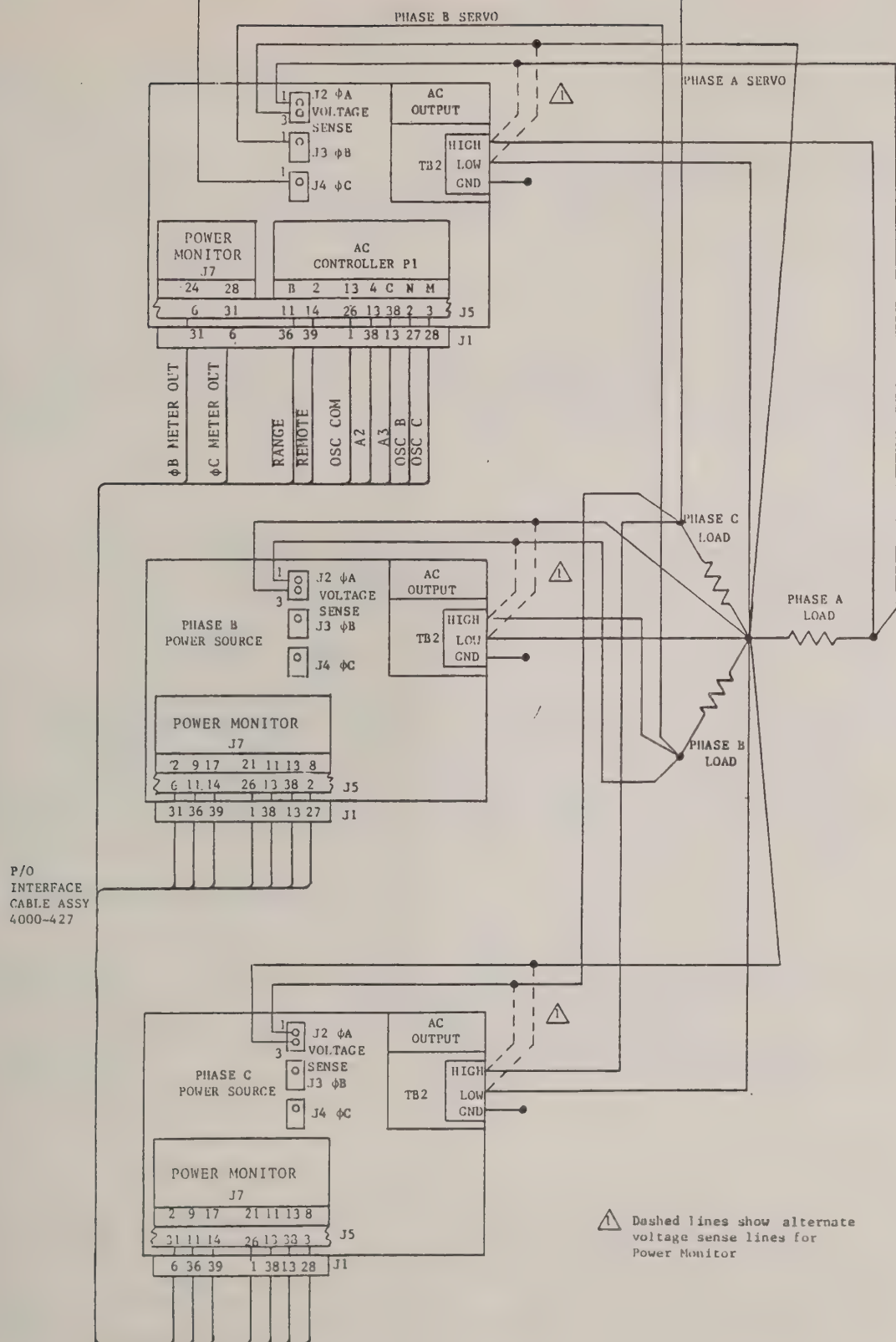


FIGURE 2-1 WYE HOOKUP XP-SERIES
THREE-PHASE POWER SOURCE SYSTEM CONNECTIONS USING THREE INDIVIDUAL UNITS
NOTE: SET THE PHASE SELECTOR IN EACH UNIT TO THE APPROPRIATE PHASE

SECTION III OPERATION

3.1 GENERAL

This section of the manual describes the operation of the Power Monitor front panel controls and switches.

3.2 FRONT PANEL CONTROLS

3.2.1 METER

The meter is a three digit meter which consists of three LED seven-segment displays. Each display presentation (screen) shows the operating output voltage, current or power of the XP-Series AC power source in which the IMC1 Power Monitor is used.

3.2.2 FUNCTION KEYS WITH ANNUNCIATORS

There are three function keys. The three function keys are for selecting Volts, Amps, and kiloWatts. Only one function can be selected at a time. When a function key is depressed, the corresponding function annunciator is illuminated.

3.2.3 RANGE KEY WITH ANNUNCIATOR

The range key on the front panel is to select either low or high range manually for the XP-Series AC power source in which the Power Monitor is used. When the range key is depressed, the range control relay at the back of the AC power source is activated and one of the low or high ranges is selected. When the high range is selected, the annunciator inside the range key is illuminated.

3.2.4 OVERTEMPERATURE INDICATOR

The overtemperature LED on the front panel indicates if the corresponding XP-Series AC power source in which the monitor is used, is operating at an excessive temperature. When this occurs, the output power is automatically reduced to zero. When the heatsink cools down sufficiently, the output power will automatically return to its previous value and the overtemperature LED is turned off.

3.2.5 OVERLOAD INDICATOR

The overload LED on the front panel indicates the XP-Series AC power source is operating in an overload condition. When this occurs, the output power is automatically reduced. When the overload condition is removed, the output power will automatically return to its previous value and the overload LED is turned off.

3.3 LOCAL/REMOTE OPERATION

In local mode of operation all the front panel controls explained in section 3.2 are enabled. When the monitor is in remote mode of operation, all the front panel controls are disabled. The function and range selection and output voltage control are done remotely through the oscillator/AC power controller used in the same AC power source.

SECTION IV THEORY OF OPERATION

4.1 GENERAL

The IMC1 Power Monitor is used in California Instruments XP-series AC power Sources to display digitally the output voltage, current or power of the power source.

The block diagram of the IMC1 Power Monitor is shown in figure 4-1. There are three boards used in IMC1. These boards are the Display board, the Driver board and the Servo board. The operation of each board is described in detailed circuit description, section 4.2.

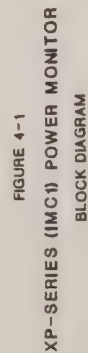
4.2 DETAILED CIRCUIT DESCRIPTION

4.2.1 DISPLAY BOARD

All the front panel controls are located on this board.

4.2.1.1 FRONT PANEL KEYS DECODING

The function keys on the Display board are decoded through a sequential scanning circuit. It consists of 1-of-8 decoder (U3), decade counter (U6) on the Display board and the control oscillator on the Driver board. When all the keys are up, the oscillator runs freely at about 1.3 KHz. The counter sequences in modulo 10 and activates, one after the other, the open collector outputs of decoder U3. The key contacts are connected to the decoder outputs, and the common is pulled to +5 volts through R1 on the Driver board. Everytime the counter number corresponds to the selected key, the common is pulled to ground. This causes the oscillator to stop and provide low level at the clock input to the decade counter indicating that the counter output corresponds to the number of the depressed key.



4.2.1.2 DISPLAY DRIVER

This section drives the display on the front panel of the IMC1 Power Monitor. The Display driver consists of A-to-D convertor (U5), BCD to seven segment decoder (U4), transistors Q1, Q2, Q3 and associated components. The A-to-D convertor receives its DC analog input from the Servo board and converts it into 4 bit binary coded digit (BCD). The BCD outputs derived by the A/D convertor are multiplexed to the decoder (U4). Multiplexing of the BCD outputs reduces the total power requirement and thereby assures more efficient circuit operation. The U4 decoder decodes the multiplexed BCD signals into seven line outputs that represent a decimal number from 0 to 9 on the 7-segment digital displays. The decoder circuit includes seven constant-current segment drivers that eliminate the need for any current limiting resistor.

If the input to A/D convertor is too negative, display shows --- and if the input is too positive ($>1V_{DC}$), display shows EEE.

4.2.1.3 PHASE AND FUNCTION ANNUNCIATOR DRIVERS

The transistor array U1 provides three active low outputs which drive the three function LEDs. Only one function LED is on at a time. Driver U1 receives its high logic inputs from the Driver board. The inputs are decoded function logic lines.

4.2.1.4 RANGE ANNUNCIATOR AND RANGE RELAY DRIVER

The transistor array U2 provides 2 active low outputs, one for high range LED and one for driving the range control relay at the back of AC power source in which the monitor is used. When the range key is depressed, depending on high or low range, the inputs to U2 are high or low logics respectively. When the high range is selected, the range LED is turned on and the range control relays are activated.

4.2.1.5 OVERTEMPERATURE AND OVERLOAD INDICATORS

These indicators indicate if the XP-Series AC power source is in overtemperature or any overload condition. The signals for driving these indicators come from the preamplifier board of the AC power source.

4.2.2 DRIVER BOARD

Major part of digital circuitry of the monitor is located on this board.

4.2.2.1 CONTROL OSCILLATOR

This oscillator consists of parts of U9, parts of U8, part of U7, C2 and R3 on the Driver board. This oscillator runs freely at about 1.3 KHz when no key on the front panel is depressed. When a key is depressed, the oscillator stops and its output is high. When the key is released, its output goes low and triggers the monostable U4. This oscillator also provides the clock input to the decade counter (U6) on the Display board. The T.B.D. resistor, R3, 120K ohm, nominal) is to assure the oscillator frequency stays about 1.3 KHz.

4.2.2.2 STROBE GENERATOR

The strobe generator circuitry provides strobe lines needed by the tri-state latch U1. When no key is depressed, the control oscillator is providing pulses for U4 and the $\bar{Q}$ -output of U4 is low. Hence, the outputs of parts of U7 are low. When the strobe lines are low, the tri-state latch holds the input information until the strobe lines go high and then sends it out. When a key is depressed, the oscillator stops, and the $\bar{Q}$ -output of U4 goes high. When the output of U4 or the input of U5 goes high, U5 is triggered and one of its outputs goes high. U5 receives its D-input from the third output line (Q2) of decade counter (U6) on the Display board. When one of the function keys is depressed, D-input is high, and hence, Q-output is high which means that strobe line for the function section of U1 goes high. When the depressed key is released, the monostable is triggered and its $\bar{Q}$ -output goes low after a time delay set by C1 and R2.

4.2.2.3 FRONT PANEL ADDRESS LINES GENERATOR

The dual tri-state latch (U1) generates the two functions address lines. U1 receives its inputs from the 1-of-8 decoder on the Display board. The Enable inputs of U1 are grounded so that U1 is always enabled to receive the inputs and holds them until the strobe line goes high. U1 is initialized for all logic low outputs through the set circuit so that when the Power Monitor is turned on, the "Volts" function LED is illuminated.

4.2.2.4 LOCAL/REMOTE ADDRESS LINES SELECTOR

The four address lines coming from the oscillator/AC power controller used in the XP-Series AC power source (remote address lines) and the four address lines generated by U1 (local address lines) go into U2 which is a dual tri-state latch. One section of U2 is for latching and sending out the local address lines and the other section is used for remote address lines. Both strobes are high which means anytime any section is active, the input data would be sent to output immediately. The Enable inputs of U2 are the remote and remote logic lines. Since the output of U2 is tri-state, the corresponding outputs of the two sections of U2 are tied together so that there are overall four lines coming to the decoder U3.

4.2.2.5 FUNCTION DATA LINES GENERATOR

The 1-of-4 decoder (U3) is used to generate functions data lines. The two function address lines coming from U2 are decoded into function data lines. These data lines are the inputs to the U1 on the Display board. The operation of U1 has been explained in section 4.2.1.3.

4.2.2.6 LOCAL/REMOTE RANGE CONTROLLER

Half of the retriggerable monostable (U4) is used to control local/remote range changing. The clock input of U4 comes from the range relay lockout circuitry on the Servo board. At the low level of the oscillator input to the power source (0 to 0.35V rms) the clock input of this section of U4 is high and its $\bar{Q}$ -output is high. In local mode of operation, whenever the range key is depressed, the clock input to the second half of U5 goes high and that triggers the second half of U5. This section of U5 acts as a toggle flip flop and one of its outputs Q or $\bar{Q}$ is always high indicating low or high range respectively. This flip-flop is set initially by the set circuit to have Q-output high. So when the monitor is turned on the AC power source is on low range.

The set circuit consists of part of U8, R8, CR1 and C6. When the monitor is powered up, the output of U8 is high initially and it goes low after a time delay set by R8 and C6.

When the monitor is in remote mode, the front panel range key is disabled and the range changing is done only by range input logic. The range input logic is inverted and is fed into the local/remote range selector. When the oscillator input goes above 0.35V rms, the monostable U4 receives its clock pulses, and $\bar{Q}$ -output goes low after a time delay set by R6 and C4 and the front panel range key is disabled. This is done to protect the power source from any catastrophic failure due to range change at high output levels.

4.2.2.7 RANGE KEY DEBOUNCER

When the range key is depressed, it bounces and the bouncing may cause some ambiguity in the front panel range key decoding. The debouncer circuit consisting of parts of U9, R5 and C3 set a delay time in which the range key is debounced and a clear logic line goes to the input of part of U7.

4.2.2.8 LOCAL/REMOTE RANGE SELECTOR

The local/remote range selection is done by the tri-state buffer (U6). The high range lines from the front panel and remote come to U6. Since the outputs of U6 are tri-state, the two outputs corresponding to the high range are tied together, making one range logic code. The disable inputs of U6 are the remote and remote logic lines. When remote is low, the remote mode section of U6 is operating and when remote is high, the local section of U6 is operating. The output of U6 goes to the input of range annunciator and range relay driver (U2) on the Display board.

4.2.3 SERVO BOARD

The analog circuitry of the Power Monitor is located on this board.

4.2.3.1 PRECISION RECTIFIER (VOLTS AND AMPS)

There are two precision rectifier circuits. One is used for rectifying the "AC Volts" signal and the other one is for rectifying the "AC Amps" signal. Operational amplifier (U2) is used as a gain stage to boost the AC signal levels. The full wave precision rectifier for "AC Volts" consists of U3 and its associated components. The full wave precision rectifier for "AC Amps" consists of U4 and its associated components. The outputs of these two circuits go to the analog multiplexer (U5).

4.2.3.2 MULTIPLIER

The multiplier consists of U1 and its associated components. The amplified "AC Amps" signal is amplified through half of U6. The amplified "AC Volts" and "AC Amps" are the inputs to the multiplier (U1). The multiplied signal which is equivalent to the output kilowatts is divided down to a proper level through R4, R5 and R6.

4.2.3.3 FUNCTION SELECTOR

The rectified "AC Volts", "AC Amps" and the "kilowatts" signals are the inputs to the analog multiplexer (U5). This multiplexer selects one of the functions based on the information on the function address lines and sends it to the low-pass filter.

4.2.3.4 ACTIVE LOW-PASS FILTER

The active low-pass two-pole filter consists of part of U6 and its associated components. The selected function out of U5 is fed into the filter to be converted into a DC voltage level. The output of the filter is amplified and is sent to the analog multiplexer (U8). In a three-phase system in which IMC1 is used, the DC signal outputs of low-pass filters of the other two units are also the inputs to U8. One of these DC signals is selected based on the information on the phase address lines coming from the Driver board. The phase address lines are generated by the oscillator/AC controller used in the power source and are used in the remote mode of operation.

4.2.3.5 RANGE RELAY LOCKOUT

The clock input to part of U4 on Driver board which is used in range key decoding circuitry is provided by the range relay lockout circuitry. This section consists of amplifier (U7) and its associated components. The oscillator output is the input to U7. The output of this circuit is low for inputs between 0 to about 0.35 volts rms. The output then becomes a square wave when the oscillator output is increased above 0.35 volts rms and any range changing is prevented over this input level. This is to protect the AC power source from any damage due to range changing at high output levels.

SECTION V CALIBRATION PROCEDURE

5.1 GENERAL

The following calibration and test procedures, or any part of these, may be performed on a routine basis to ensure that the IMC1 Power Monitor remains within specification tolerances. These procedures should always be performed after any repairs have been made to the unit. For your convenience, Table 5-1 lists the paragraph titles and page numbers for the calibration and test procedures.

TABLE 5-1
CALIBRATION PROCEDURE LISTING

PARAGRAPH	PROCEDURE	PAGE
5.2	Test Equipment Required	20
5.3	Initial Settings	20
5.4	Control Oscillator Frequency Adjustment	20
5.5	Low Level and Full Scale Adjustments	20
5.5.1	"Volts" Adjustments	20
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5.6	Range Change Test	23
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5.8	Overload Indicator Check	23
5.9	<u>Remote</u> Mode of Operation	23
5.10	Frequency Response Test	24
5.11	Linearity Test	24

TABLE 5-2
ADJUSTABLE COMPONENT LISTING FOR IMC1

CIRCUIT DESIGNATOR	VALUE	DESCRIPTION	PARAGRAPH
Display Board			
R8	50K	Low Level Adjustment for Meter	5.5.1
R7	10K	Full Scale Adjustment for Meter	5.5.1
Driver Board R9	10K	Internal "Gain" Control	
Servo Board			
R3	20K	Zero Adjustment for "kiloWatts"	5.5.3
R6	20K	Full Scale Adjustment for "kiloWatts"	5.5.3
R18	100K	Low Level Adjustment for "Volts"	5.5.1
R23	100K	Low Level Adjustment for "Amps"	5.5.2
R34	10K	Full Scale Adjustments for "Volts"	5.5.1

NOTE: All resistors are in ohms

5.2 TEST EQUIPMENT REQUIRED

The following test equipment is required to perform the calibration procedure.

- a. ± 18 Volts DC supplies
- b. +5 Volts DC supply
- c. Two sine wave generators
- d. Two multimeter, Keithley 190 Programmable DMM or equivalent
- e. Oscilloscope, Tektronix 2235 or equivalent

5.3 INITIAL SETTINGS

Apply ± 18 volts and +5 volts DC voltages to the Power Monitor per figure 5.1. Connect the two sine wave generators to the monitor per figure 5.1. One of the generators is used for "AC Volts" sense signal and one is used for "AC Amps" sense signal. Set the output of both to zero volts. Use a 1K pot in series with AC signal to the "AC Amps" input. This pot is to set the exact voltage signal equivalent of output current. Connect a 220K ohm resistor, 1/4W, 5% from TP5 to "A" ground. (Note the 220K ohm resistor is not required when IMC1 is calibrated in a power source containing an XP Power Controller with measurement option.)

5.4 CONTROL OSCILLATOR FREQUENCY ADJUSTMENT

Connect scope probe to TP1 on the Driver board. The frequency of oscillation should be 1.3 KHz ± 0.13 KHz. If not, use R3 to set the frequency to the correct level.

5.5 LOW LEVEL AND FULL SCALE ADJUSTMENTS

Turn on the power supplies and the sine wave generators.

5.5.1 "Volts" Adjustments

- 1) Set the "AC Volts" sine wave generator to 0.24 $\pm 10\%$ volts rms at 400 Hz (0.24 volts is equivalent to 10 volts at output of AC power source). Use R18 on the Servo board to set the reading at TP4 to 0.1 VDC ± 0.5 mV DC.
- 2) Use R8 on the Display board to set the reading on the display to 010.
- 3) Set the "AC Volts" sine wave generator to 6.43 $\pm 5\%$ volts rms at 400 Hz. (6.43 volts is equivalent to 270 volts at the output of the power source). Use R34 on the Servo board to set the voltage at TP4 to 2.7V ± 0.5 mV DC.

- 4) Use R7 on the Display board to set the reading on the display to 270.
- 5) Repeat 1-4 and check for adjustment interactions.

5.5.2 "Amps" Adjustments

- 1) Press the "Amps" key. Set the "AC Amps" sine wave generator to $0.0012 \pm 10\%$ volts rms at 400 Hz. Use R23 on the Servo board to set the voltage at TP4 to $0.012V \pm 0.5mV$ DC ($1.2 \text{ Amp} = 325VA/270V$). The display should read 01.2 ± 1 digit.
- 2) Set the "AC Amps" generator to $0.247 \pm 1\%$ volts rms at 400 Hz. If needed, use a 1K pot to set the voltage at TP4 to $2.47 \pm 0.5mV$ DC. The display should read 24.7 ± 1 digit.
- 3) Repeat steps 1 and 2 and check for adjustment interactions.

5.5.3 "KiloWatts" Adjustments

- 1) Press the "kiloWatts" key. Set the "AC Volts" input to $0.24 \pm 5\%$ volts rms and "AC Amps" input to $0.0012 \pm 10\%$ volts rms. Use R3 on the Servo board to set the voltage at TP4 to $0.0012V \pm 0.5mV$ DC. Display should read 0.00.
- 2) Set the "AC Volts" input to $6.43 \pm 5\%$ volts rms and the "AC Amps" input to $0.06173 \pm 1\%$ volts rms at 400 Hz. Use R6 on the Servo board to set the voltage at TP4 to $1.67 \pm 0.5mV$ DC. Display should read 1.67 ± 1 digit.
- 3) Repeat 1-2 and check for adjustment interactions.

NOTE

Remove 220K ohm resistor after calibration of the Power Monitor.

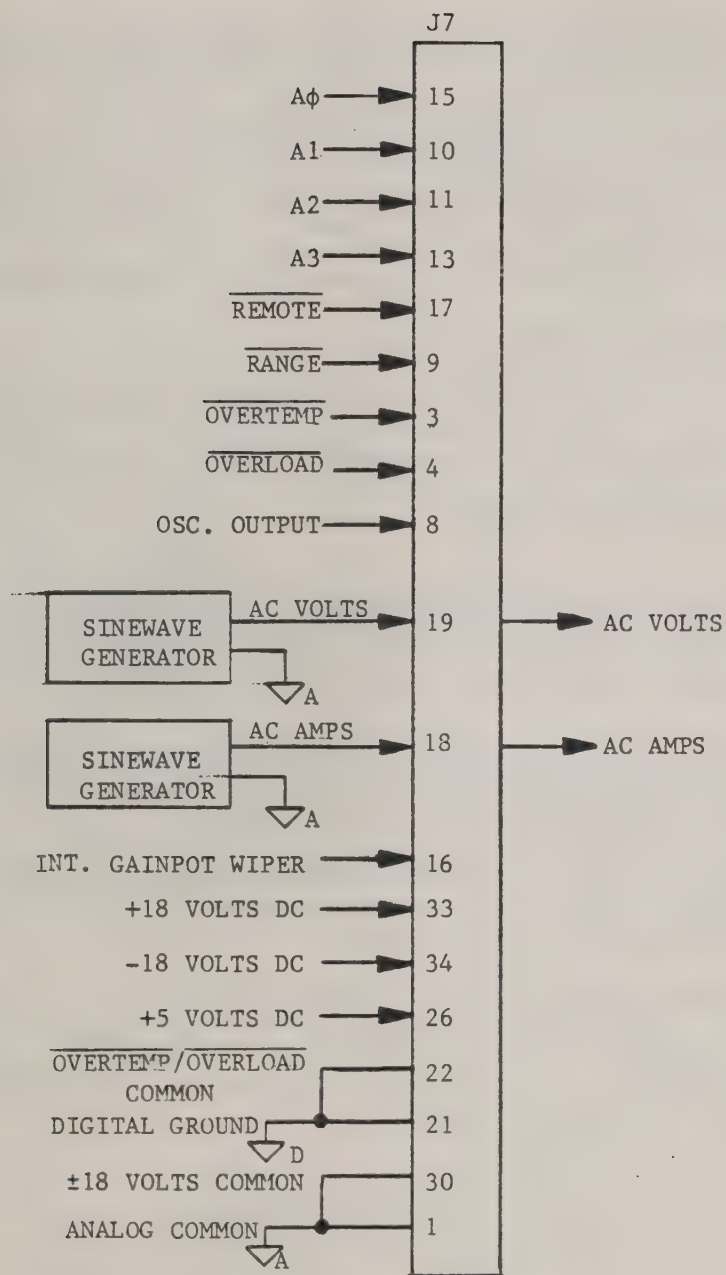


FIGURE 5.1. External Connections to the IMC1 Power Monitor

5.6 RANGE CHANGE TEST

Use one of the sine wave generators mentioned before as the oscillator output signal. Set the signal level to anywhere between zero and about 0.35 volts rms. Press the range key. Verify that the range annunciator is illuminated indicating the high range. If the range key is depressed again, the light will be extinguished indicating the low range. Each time the range key is depressed, the range level changes. Increase the oscillator output to more than 0.35 volts rms. Verify that the range key is disabled and no range changing can be done.

5.7 OVERTEMPERATURE CHECK

Apply low logic (zero volts DC) to overtemp input of the monitor. (See figure 5.1). Verify that the indicator is turned on and stays on until the low logic is removed from the input.

5.8 OVERLOAD INDICATOR CHECK

Apply a low logic (zero volts DC) to overload input of the monitor. (See figure 5.1). Verify that the indicator is turned on and stays on until the low logic is removed from the input.

5.9 REMOTE MODE OF OPERATION CHECK

1. Apply a low logic (zero volts DC) to remote input of the monitor (See figure 5.1). Verify that all the front panel controls are disabled.
2. Apply a low logic to range input of the monitor. Verify that the range annunciator is turned on indicating the high range.
3. All four address lines coming from the oscillator/AC power controller are pulled to high logic (+5 volts). To verify the reading of "Volts", "Amps" or "kiloWatts", apply low logics to the address lines based on the table below.

A3	A2	Function
0	0	Volts
0	1	Amps
1	0	kiloWatts

The above table is also used to verify the correct operation of functions annunciators.

5.10 FREQUENCY RESPONSE TEST

1. Set the AC signals at "AC Volts" and "AC Amps" inputs to $6.43 \pm 5\%$ volts rms and $0.06173 \pm 1\%$ volts rms at 400 Hz respectively.
2. Vary the operating frequency of the Power Monitor from 45 Hz to 5 KHz and read the display. The reading should vary by 1 digit maximum for "volts", "Amps" and "kiloWatts".

5.11 LINEARITY TEST

If not already accomplished, connect the Power Monitor per figure 5.1 and adjust low level and full scale readings on the display as described in section 5.5.

1. Press "Volts" key. Reduce the AC signal at "AC Volts" input to different values less than $6.43 \pm 5\%$ volts rms. Display reading should stay within ± 1 digit of the applied signal.
2. Press "Amps" key. Reduce the AC signal at "AC Amps" input to different values less than $0.247 \pm 1\%$ volts rms. Display reading should stay within ± 1 digit of the applied signal.
3. Press "kiloWatts" key. Change the input signal to "AC Amps" circuit to $0.06173 \pm 1\%$ volts rms. Display should read 1.67. Reduce either of AC signals to "AC Volts" or "AC Amps" inputs for different kiloWatts readings. Display reading should stay within ± 5 digits of the calculated value.

SECTION VI MAINTENANCE AND TROUBLESHOOTING

6.1 GENERAL

The California Instruments IMC1 Power Monitor requires no maintenance. If any problem appears in the Power Monitor, it must be isolated to a specific section of the monitor. The procedures explained for troubleshooting in section 6.2 assume that the monitor is in the power source and all the input signals come from the power source. If the monitor is separated from the power source, then external sources can be used for input signals.

6.2 TROUBLESHOOTING

6.2.1 EXTERNAL CHECK

Check that all the signal inputs to the monitor are of proper amplitude and frequency.

6.2.2 CHECK DC POWER SUPPLY

Check all DC power supply voltages. Information concerning power supplies is given in paragraph 2.3 of this instruction manual.

6.2.3 CHECK DISPLAY BOARD

- a) Check that all the front panel keys are operating properly.
- b) Check that the range key operates properly.
- c) Check that the display reads the voltage at the output for either function.

The operation of the Display board is explained in Section 4.2.1 of this instruction manual.

6.2.4 CHECK DRIVER BOARD

- a) Check that the control oscillator is operating properly and its frequency is correct. Refer to Section 4.2.2.1 for more information.
- b) Check that the decoding logic of the front panel keys is correct.
- c) Check that the range decoding circuit operates properly.

The operation of the Driver board is explained in Section 4.2.2 of this instruction manual.

6.2.5 CHECK SERVO BOARD

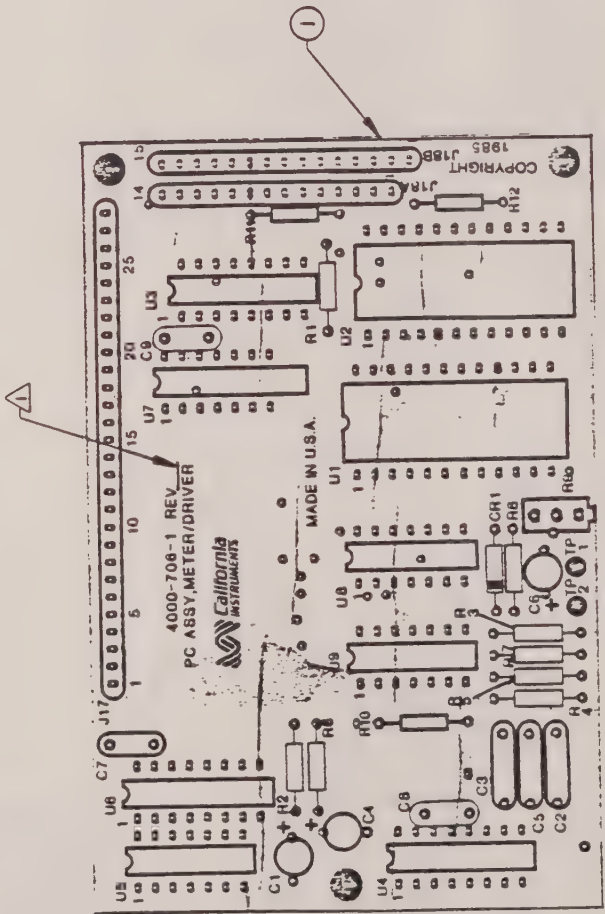
- a) Check that the "Volts" circuit operates properly and the correct voltage value is available for associated oscillator/AC controller and Display board.
- b) Check that the "Amps" circuit operates properly and the correct voltage value is available for associated oscillator/AC controller and Display board.
- c) Check that the "Watts" circuit operates properly and the correct voltage value is available for associated oscillator/AC controller and Display board.
- d) Check that the active low-pass filter is operating properly.
- e) Check that the function selector is operating properly and the correct function is sent through.
- f) Check that the range delay lockout circuit is operating properly.

The operation of the Servo board is explained in Section 4.2.3 of this instruction manual.

SECTION VII CIRCUIT DIAGRAMS

This section contains schematics and mechanical diagrams necessary for operation of the IMCl Power Monitor. The schematic diagrams illustrate the circuit while the mechanical assemblies indicated the part placement.

REVISIONS		
REV	DESCRIPTION	DATE
B	REMOVE S1, R10, U7, U9, AND R10, 11, 12, U7, B, 9	8/2/85
C	REVISED PL	8/14/87 JTC

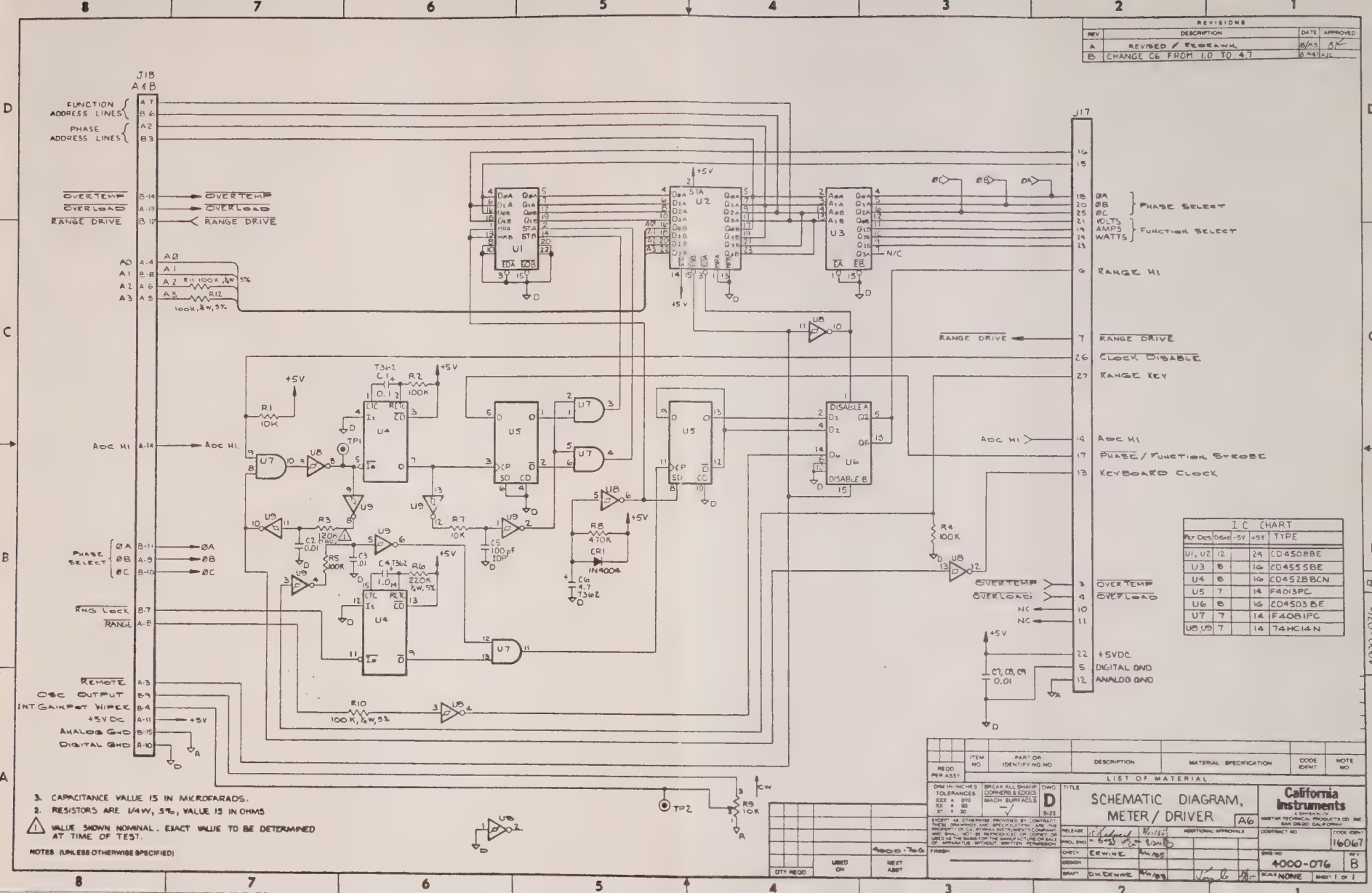


PRINTED WIRING BOARD REV "A" SHOWN

FOR PARTS LIST SEE PL 4000-706-1.

ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	MATERIAL SPECIFICATION	CODE IDENT	NOTE NO																														
LIST OF MATERIAL																																			
PC ASSY METER/DRIVER																																			
<table border="1"> <thead> <tr> <th>RELEASE</th> <th>PROJ ENG</th> <th>CHECK</th> <th>DESIGN</th> <th>CHART</th> </tr> </thead> <tbody> <tr> <td>8/2/85</td> <td>8/2/85</td> <td>8/2/85</td> <td>8/2/85</td> <td>8/2/85</td> </tr> </tbody> </table>						RELEASE	PROJ ENG	CHECK	DESIGN	CHART	8/2/85	8/2/85	8/2/85	8/2/85	8/2/85																				
RELEASE	PROJ ENG	CHECK	DESIGN	CHART																															
8/2/85	8/2/85	8/2/85	8/2/85	8/2/85																															
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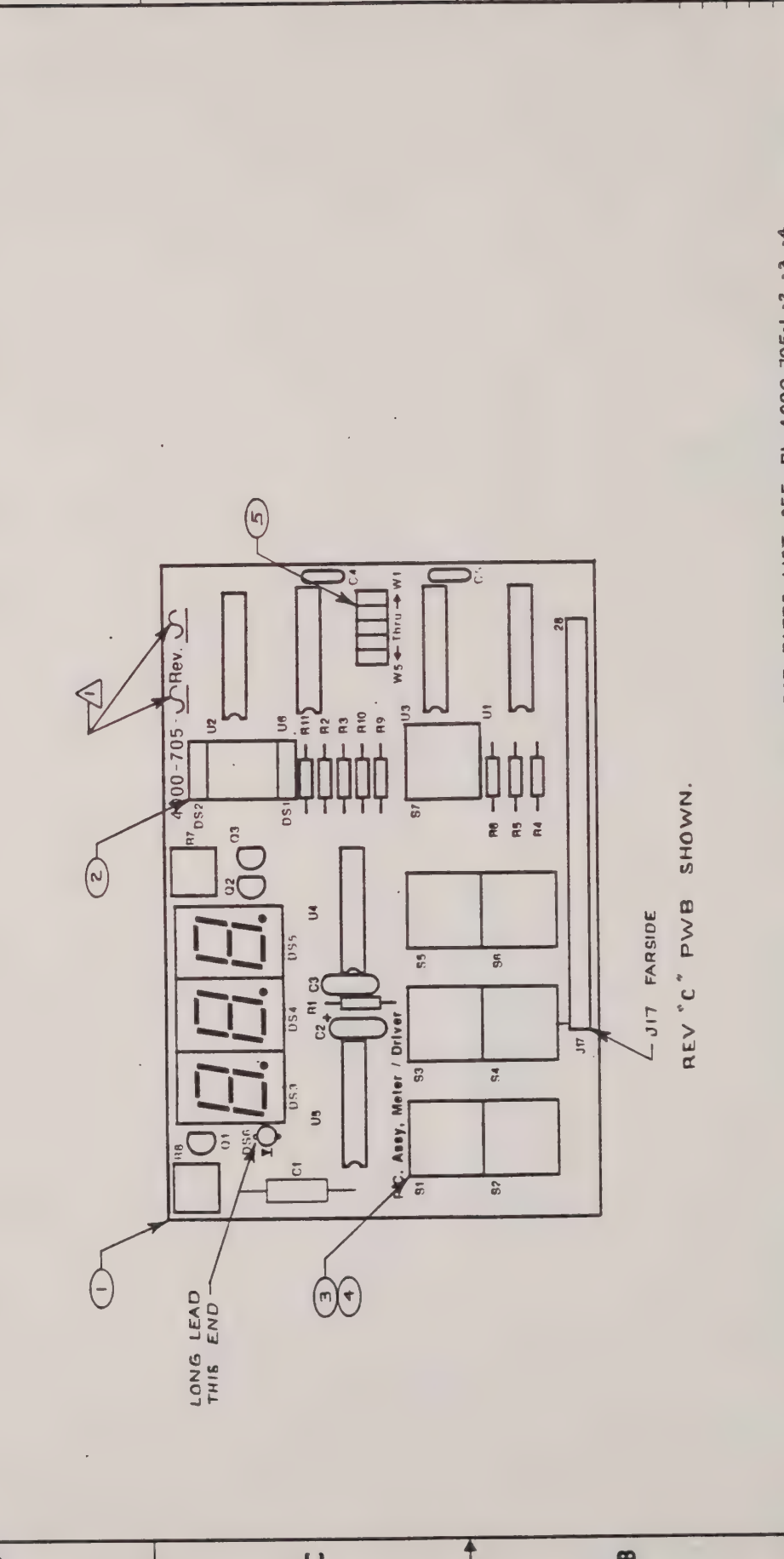
2. FOR SCHEMATIC SEE 4000-076.
 Δ MARK WITH APPROPRIATE REV LTR
 NOTES: (UNLESS OTHERWISE SPECIFIED)



4 3 2 1

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
D	REVISED AND REDRAWN	5-11-86	PM
E	REMOVED "FARSIDE" NOTE FROM (5)		PM
F	REVISED PARTS LIST	11/86	

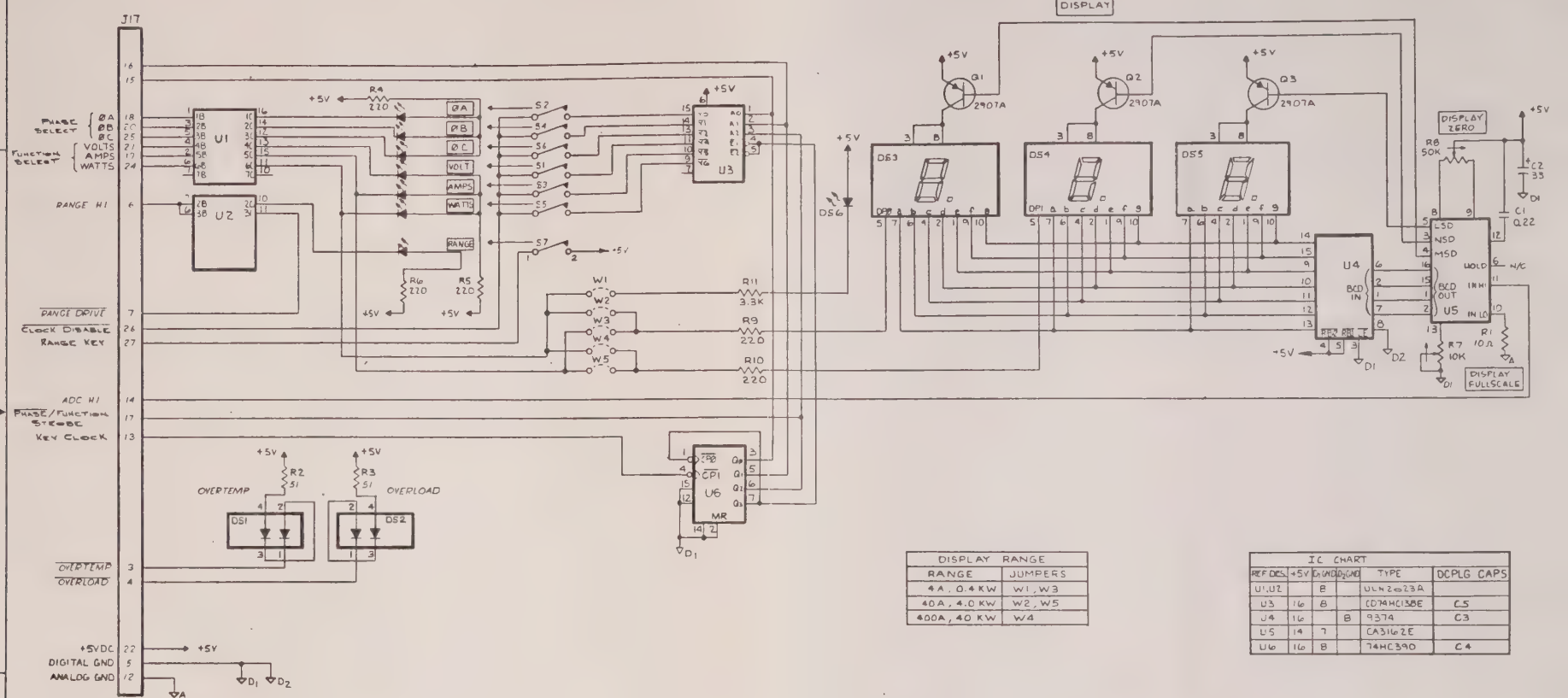
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FOR PARTS LIST SEE PL 4000-705-1, 2, 3, 4

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XX ± .00		XX ± .00		XX ± .00				DWG NO		4000-705	
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XX ± .00		XX ± .00		XX ± .00				SCALE		2 1/4"	
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XX ± .00		XX ± .00		XX ± .00				DESIGN			
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REVISIONS			DATE	APPROVED
REV	DESCRIPTION			
A	REVISED AND REDRAWN		11-84	JAL
B	ADD W1 THRU W4, R11 AND DS6		5-85	JAL



DISPLAY RANGE	
RANGE	JUMPERS
4 A, 0.4 KW	W1, W3
40 A, 4.0 KW	W2, W5
400 A, 40 KW	W4

IC CHART			
REF DES	+5V GND	TYPE	DCPLG CAPS
U1, U2	B	ULN2823A	
U3	B	CD4013BE	C5
U4	B	9374	C3
U5	7	CA3142E	
U6	B	74HC390	C4

2. CAPACITANCE VALUE IS IN MICROFARADS.
 1. RESISTORS ARE 1/4W, $\pm 5\%$, VALUE IS IN OHMS.
 NOTES: (UNLESS OTHERWISE SPECIFIED)

ITEM NO.	PART OR IDENTIFYING NO.	DESCRIPTION	MATERIAL SPECIFICATION	CODE IDENT	NOTE NO.						
RECD PER ASSY											
LIST OF MATERIAL											
<table border="1"> <tr> <td>QTY REQD</td> <td>USED ON</td> <td>RECY ASSY</td> <td>FRSH</td> <td>4000-075</td> <td>16067</td> </tr> </table>						QTY REQD	USED ON	RECY ASSY	FRSH	4000-075	16067
QTY REQD	USED ON	RECY ASSY	FRSH	4000-075	16067						
<table border="1"> <tr> <td>QTY REQD</td> <td>USED ON</td> <td>RECY ASSY</td> <td>FRSH</td> <td>4000-075</td> <td>16067</td> </tr> </table>						QTY REQD	USED ON	RECY ASSY	FRSH	4000-075	16067
QTY REQD	USED ON	RECY ASSY	FRSH	4000-075	16067						
<table border="1"> <tr> <td>QTY REQD</td> <td>USED ON</td> <td>RECY ASSY</td> <td>FRSH</td> <td>4000-075</td> <td>16067</td> </tr> </table>						QTY REQD	USED ON	RECY ASSY	FRSH	4000-075	16067
QTY REQD	USED ON	RECY ASSY	FRSH	4000-075	16067						

California Instruments 4000-075 B 16067	
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SECTION VIII

REPLACEABLE PARTS

8.1 GENERAL

This section contains ordering information and a complete list of replaceable parts. The parts are listed by their major assembly in alpha-numeric order by their reference designators. The list includes the parts description, manufacturers' identification (see Appendix A for list of manufacturers), and California Instruments' part numbers.

8.2 ORDERING INFORMATION

In order to ensure prompt, accurate service, please provide the following information, when applicable, for each replacement part ordered.

- a. Model number and serial number of the instrument.
- b. California Instruments part number for the sub-assembly where component is located (PARENT ITEM NO.).
- c. Component reference designator (SEQ NO.).
- d. Component description (DESCRIPTION TRUNCATED).
- e. Component manufacturer's FSCM number (VENDOR).
- f. California Instruments part number (COMPONENT ITEM NO.).

A further explanation of these terms can be found in Section 7.3.

All replacement part orders should be addressed to:

California Instruments
Attention: Parts Department
5150 Convoy Street
San Diego, California 92111-1266

8.3 COMPUTER GENERATED PARTS LISTS

The following information is included as an explanation of the computer formatted parts list column.

- 8.3.1 "SEQ NO." - Sequence Number: the reference designator or the component, or (if there is no reference designator) the balloon number (bubble or "find" number) on the face of the assembly drawing or the top assembly drawing. They are listed in alpha-numeric order.
- 8.3.2 "COMPONENT ITEM NO." - This is California Instruments' part number. Please use this number when ordering spares or replacements.
- 8.3.3 "DESCRIPTION TRUNCATED" - A brief description of the item. The abbreviations are per MIL-STD-12 or industry accepted standards.
- 8.3.4 "ENGINEERING DRAWING NUMBER" - This is used for one of the following:
 - a. The document/specification number generated by California Instruments to control the part.
 - b. The generic part number (military specifications or industry accepted standard).
 - c. The primary vendor's catalog part number. An asterisk at the end of the number indicates number is longer than that shown. (Contact California Instruments if the full number is required.)
- 8.3.5 "VENDOR" - This is the FSCM code to identify the manufacturer. (See Appendix A).
- 8.3.6 "QTY" - This is the Quantity and Unit of Measure used in the assembly. The Unit of Measure abbreviations are per MIL-STD-12 or industry accepted standard.

PARENT ITEM NO.
4000-423-2

TOP ASSY,IMC1
ENGR DRAW NO. 4000-423 REV F

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1/14/87

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
A1	4000-705-2	PC ASSY,METER/DISPLAY	4000-705 REV F	16067	1.0	EA
A2	4000-706-1	PC ASSY,METER/DRIVER	4000-706 REV B	16067	1.0	EA
A3	4000-719-1	PC ASSY,METER/SERVO	4000-719 REV E	16067	1.0	EA
1	4000-267-1	PANEL,FRONT W/4000-267	4000-267-1	16067	1.0	EA
2	240325	FSTNR,CAPTIVE SCREW	51-28-506-24	94222	2.0	EA
3	4000-291-1	INSULATOR	4000-291-1	81349	1.0	EA
4	210861	SPACER, #4 X 1/4",NYLON	9209-1-115	06540	3.0	EA
5	210862	SPACER, #4 X 1/2",NYLON	9213-N-115	06540	3.0	EA
6	FS1111	SCREW,PNH,S/S,40-40X1-3/8	MS51957-122	81349	3.0	EA
7	FS1072	WASHER,SPLT,S/S,#4	MS35338-135	96906	3.0	EA
8	210750	LENS W/BEZEL	P1316-2-R60	000AU	1.0	EA
10	210533	INSULATOR,WSHR,NYL,#4	NW4-2813	95987	3.0	EA

PARENT ITEM NO.
4000-706-1

PC ASSY,METER/DRIVER
ENGR DRAW NO. 4000-706 REV C

PAGE 1
8/14/87

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
CR1	310062	DIODE,RECT,1A,400V,DO41	1N4004	81349	1.0	EA
C1	610767	CAP,TANT,.1UF,35V	T362A104M035AS	05397	1.0	EA
C2	610929	CAP,MYLAR,.01UF,400V	712A1BB103PK40*	80031	1.0	EA
C3	610929	CAP,MYLAR,.01UF,400V	712A1BB103PK40*	80031	1.0	EA
C4	610796	CAP,TANT,1UF,35V	T362A105M035AS	05397	1.0	EA
C5	610027	CAP,MICA,100PF,500V	CM05F101J03	81349	1.0	EA
C6	610750	CAP,TANT,4.7UF,10V	T362A475M010AS	05397	1.0	EA
C7	610094	CAP,CER,.01UF,50V	CK103	71590	1.0	EA
C8	610094	CAP,CER,.01UF,50V	CK103	71590	1.0	EA
C9	610094	CAP,CER,.01UF,50V	CK103	71590	1.0	EA
J18A	410427	CABLE ASSY,FLEX,14COND2"	J-14-24-1-G-2.0	08261	1.0	EA
J18B	410374	CABLE ASSY,FLEX,15COND2"	J-15-24-1-G-2.0	08261	1.0	EA
R1	510076	RES,CARB,1/4W,10K OHM	RC07GF103J	81349	1.0	EA
R2	510100	RES,CARB,1/4W,100K OHM	RC07GF104J	81349	1.0	EA
R3	510102	RES,CARB,1/4W,120K OHM	RC07GF124J	81349	1.0	EA
R4	510100	RES,CARB,1/4W,100K OHM	RC07GF104J	81349	1.0	EA
R5	510100	RES,CARB,1/4W,100K OHM	RC07GF104J	81349	1.0	EA
R6	510108	RES,CARB,1/4W,220K OHM	RC07GF224J	81349	1.0	EA
R7	510076	RES,CARB,1/4W,10K OHM	RC07GF103J	81349	1.0	EA
R8	510115	RES,CARB,1/4W,470K OHM	RC07GF474J	81349	1.0	EA
R9	570279	POT,MT,PC,10K,1/4W,10%	64X103T000	02111	1.0	EA
R10	510100	RES,CARB,1/4W,100K OHM	RC07GF104J	81349	1.0	EA
R11	510100	RES,CARB,1/4W,100K OHM	RC07GF104J	81349	1.0	EA
R12	510100	RES,CARB,1/4W,100K OHM	RC07GF104J	81349	1.0	EA
TP1	210724	TERMINAL,QCK CLP,PC,MALE	835	79963	1.0	EA
TP2	210724	TERMINAL,QCK CLP,PC,MALE	835	79963	1.0	EA
U1	360434	IC,MOS,LATCH,DUAL,4 BIT	CD4508BE	81349	1.0	EA
U2	360434	IC,MOS,LATCH,DUAL,4 BIT	CD4508BE	81349	1.0	EA
U3	360433	IC,MOS,DECODER,1 TO 4	CD4555BE	81349	1.0	EA
U4	360432	IC,MOS,MONO, MULTI,DUAL	CD4528BCN	81349	1.0	EA
U5	360197	IC,MOS,FF,DUAL	F4013PC	07263	1.0	EA
U6	360478	IC,MOS,BUFFER,HEX	CD4503BE	86684	1.0	EA
U7	360199	IC,MOS,AND,2-IN,QUAD	F4081PC	07263	1.0	EA
U8	360355	IC,MOS,INVERT,HEX,HS	74HC14N	27014	1.0	EA
U9	360355	IC,MOS,INVERT,HEX,HS	74HC14N	27014	1.0	EA
1	4000-756-1	PWB,METER/DRIVER	4000-756-1	16067	1.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
C1	610794	CAP,PC,.22UF,50V	BA2A224K	27556	1.0	EA
C2	610751	CAP,TANT,33UF,10V	T362B336M010AS	05397	1.0	EA
C3	610094	CAP,CER,.01UF,50V	CK103	71590	1.0	EA
C4	611103	CAP,CER,.1UF,50V,Z5U	CZ20C104M	71590	1.0	EA
C5	611103	CAP,CER,.1UF,50V,Z5U	CZ20C104M	71590	1.0	EA
DS1	230081	LAMP,LED,RED,LIGHT BAR	HLMP-2300	28480	1.0	EA
DS2	230081	LAMP,LED,RED,LIGHT BAR	HLMP-2300	28480	1.0	EA
DS3	230077	DISPLAY,LED,RED,.5,DGTL	HDSP5501	28480	1.0	EA
DS4	230077	DISPLAY,LED,RED,.5,DGTL	HDSP5501	28480	1.0	EA
DS5	230077	DISPLAY,LED,RED,.5,DGTL	HDSP5501	28480	1.0	EA
J17	410460	CABLE ASSY,FLEX,28CD 2.55	J-28-24-1-G-2.*	08261	1.0	EA
Q1	330285	TRANSISTOR,SS,PNP,TO92	PN2907A	07263	1.0	EA
Q2	330285	TRANSISTOR,SS,PNP,TO92	PN2907A	07263	1.0	EA
Q3	330285	TRANSISTOR,SS,PNP,TO92	PN2907A	07263	1.0	EA
R1	510005	RES,CARB,1/4W,10 OHM	RC07GF100J	81349	1.0	EA
R2	510022	RES,CARB,1/4W,51 OHM	RC07GF510J	81349	1.0	EA
R3	510022	RES,CARB,1/4W,51 OHM	RC07GF510J	81349	1.0	EA
R4	510037	RES,CARB,1/4W,220 OHM	RC07GF221J	81349	1.0	EA
R5	510037	RES,CARB,1/4W,220 OHM	RC07GF221J	81349	1.0	EA
R6	510037	RES,CARB,1/4W,220 OHM	RC07GF221J	81349	1.0	EA
R7	570289	POT,MT,PC,10K	64P103T000	02111	1.0	EA
R8	570290	POT,MT,PC,50K	64P503T000	02111	1.0	EA
R9	510037	RES,CARB,1/4W,220 OHM	RC07GF221J	81349	1.0	EA
R10	510037	RES,CARB,1/4W,220 OHM	RC07GF221J	81349	1.0	EA
S1	240504	SWITCH,PUSHBUTTON,LED	81-20-101-02	000BR	1.0	EA
S3	240504	SWITCH,PUSHBUTTON,LED	81-20-101-02	000BR	1.0	EA
S5	240504	SWITCH,PUSHBUTTON,LED	81-20-101-02	000BR	1.0	EA
S7	240504	SWITCH,PUSHBUTTON,LED	81-20-101-02	000BR	1.0	EA
U1	330326	TRANSISTOR,ARRAY,NPN,DIP	ULN2023A	56289	1.0	EA
U2	330326	TRANSISTOR,ARRAY,NPN,DIP	ULN2023A	56289	1.0	EA
U3	360357	IC,MOS,DECODER,3 TO 8	D74HC138E	18722	1.0	EA
U4	360229	IC,TTL,DECODER,LATCH	9374	07263	1.0	EA
U5	360426	IC,A/D CONVERTER	CA3162E	86684	1.0	EA
U6	360440	IC,MOS,COUNTER,DEC,OVAL	SN74HC390N	81349	1.0	EA
W2	250396	JUMPER BLOCK	90059-0009	27264	1.0	EA
W5	250396	JUMPER BLOCK	90059-0009	27264	1.0	EA
1	4000-755-1	PWB,METER/DISPLAY	4000-755-1	16067	1.0	EA
2	230082	SOCKET,DIP,08 PIN	8-6503-31	51167	1.0	EA
3	240505	SWITCH BUTTON	80-11-011-07	000BR	4.0	EA
4	240506	SWITCH,COVER W/DIFFUSOR	83-00-000-11	000BR	4.0	EA
5	410417	CONN,PC HDR,10 PIN	10-89-1101	27264	1.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
CR1	310118	DIODE,SWNG,75V,.5W,DO35	1N914	07263	1.0	EA
CR2	310118	DIODE,SWNG,75V,.5W,DO35	1N914	07263	1.0	EA
CR3	310118	DIODE,SWNG,75V,.5W,DO35	1N914	07263	1.0	EA
CR4	310118	DIODE,SWNG,75V,.5W,DO35	1N914	07263	1.0	EA
CR5	310118	DIODE,SWNG,75V,.5W,DO35	1N914	07263	1.0	EA
CR6	310006	DIODE,RECT,80V,.2A,DO7	1N270	81349	1.0	EA
CR7	310006	DIODE,RECT,80V,.2A,DO7	1N270	81349	1.0	EA
C1	610796	CAP,TANT,1UF,35V	T362A105M035AS	05397	1.0	EA
C2	610796	CAP,TANT,1UF,35V	T362A105M035AS	05397	1.0	EA
C3	611103	CAP,CER,.1UF,50V,Z5U	CZ20C104M	71590	1.0	EA
C4	611103	CAP,CER,.1UF,50V,Z5U	CZ20C104M	71590	1.0	EA
C5	611103	CAP,CER,.1UF,50V,Z5U	CZ20C104M	71590	1.0	EA
C6	610750	CAP,TANT,4.7UF,10V	T362A475M010AS	05397	1.0	EA
C7	610750	CAP,TANT,4.7UF,10V	T362A475M010AS	05397	1.0	EA
C8	611083	CAP,MYLAR,.22UF,100V	713A1BB224PK10*	80031	1.0	EA
C9	611083	CAP,MYLAR,.22UF,100V	713A1BB224PK10*	80031	1.0	EA
C10	610796	CAP,TANT,1UF,35V	T362A105M035AS	05397	1.0	EA
C11	611103	CAP,CER,.1UF,50V,Z5U	CZ20C104M	71590	1.0	EA
J7	410376	CONN,PC EDGE,17 PIN,MALE	PS17-4102-0-9	57856	1.0	EA
R3	570223	POT,MT,PC,20K	ET34X203	30983	1.0	EA
R4	560807	RES,FILM,1/8W,4.22K,1%	RN55D4221F	81349	1.0	EA
R5	560830	RES,FILM,1/8W,15K,1%	RN55C1502F	81349	1.0	EA
R6	570278	POT,MT,PC,20K	64X203T000	02111	1.0	EA
R7	560770	RES,FILM,1/8W,1K,1%	RN55D1001F	81349	1.0	EA
R8	560748	RES,FILM,1/8W,4.53K,1%	RN55D4531F	81349	1.0	EA
R9	560770	RES,FILM,1/8W,1K,1%	RN55D1001F	81349	1.0	EA
R10	560748	RES,FILM,1/8W,4.53K,1%	RN55D4531F	81349	1.0	EA
R15	560742	RES,FILM,1/8W,2K,1%	RN55C2001F	81349	1.0	EA
R16	560770	RES,FILM,1/8W,1K,1%	RN55D1001F	81349	1.0	EA
R17	560838	RES,FILM,1/8W,1.5M,1%	RN55C1504F	81349	1.0	EA
R18	570270	POT,1T,PC,100K	63X104	02111	1.0	EA
R19	510100	RES,CARB,1/4W,100K OHM	RC07GF104J	81349	1.0	EA
R20	560742	RES,FILM,1/8W,2K,1%	RN55C2001F	81349	1.0	EA
R21	560770	RES,FILM,1/8W,1K,1%	RN55D1001F	81349	1.0	EA
R22	560838	RES,FILM,1/8W,1.5M,1%	RN55C1504F	81349	1.0	EA
R23	570270	POT,1T,PC,100K	63X104	02111	1.0	EA
R24	510100	RES,CARB,1/4W,100K OHM	RC07GF104J	81349	1.0	EA
R25	510165	RES,CARB,1/4W,1 OHM	RC07GF1R0J	81349	1.0	EA
R26	560859	RES,FILM,1/8W,150K,1%	RN55C1503F	81349	1.0	EA
R27	560795	RES,FILM,1/8W,309K,1%	RN55D3093F	81349	1.0	EA
R28	510076	RES,CARB,1/4W,10K OHM	RC07GF103J	81349	1.0	EA
R29	510069	RES,CARB,1/4W,5.1K OHM	RC07GF512J	81349	1.0	EA
R30	510100	RES,CARB,1/4W,100K OHM	RC07GF104J	81349	1.0	EA
R31	510100	RES,CARB,1/4W,100K OHM	RC07GF104J	81349	1.0	EA
R33	560530	RES,FILM,1/8W,147K,1%	RN55C1473F	81349	1.0	EA
R34	570279	POT,MT,PC,10K,1/4W,10%	64X103T000	02111	1.0	EA
R35	560791	RES,FILM,1/8W,30.1K,1%	RN55D3012F	81349	1.0	EA

PARENT ITEM NO.
4000-719-1

PC ASSY,METER/SERVO
ENGR DRAW NO. 4000-719 REV B

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SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
R36	560726	RES,FILM,1/8W,499K,1%	RN55C4993F	81349	1.0	EA
R37	560770	RES,FILM,1/8W,1K,1%	RN55D1001F	81349	1.0	EA
R38	560770	RES,FILM,1/8W,1K,1%	RN55D1001F	81349	1.0	EA
R39	560835	RES,FILM,1/8W,9.09K,1%	RN55C9091F	81349	1.0	EA
R40	560770	RES,FILM,1/8W,1K,1%	RN55D1001F	81349	1.0	EA
R41	560770	RES,FILM,1/8W,1K,1%	RN55D1001F	81349	1.0	EA
R42	560762	RES,FILM,1/8W,10K,1%	RN55D1002F	81349	1.0	EA
TP1	210724	TERMINAL,QCK CLP,PC,MALE	835	79963	1.0	EA
TP2	210724	TERMINAL,QCK CLP,PC,MALE	835	79963	1.0	EA
TP3	210724	TERMINAL,QCK CLP,PC,MALE	835	79963	1.0	EA
TP4	210724	TERMINAL,QCK CLP,PC,MALE	835	79963	1.0	EA
TP5	210724	TERMINAL,QCK CLP,PC,MALE	835	79963	1.0	EA
TP6	210724	TERMINAL,QCK CLP,PC,MALE	835	79963	1.0	EA
TP7	210724	TERMINAL,QCK CLP,PC,MALE	835	79963	1.0	EA
TP8	210724	TERMINAL,QCK CLP,PC,MALE	835	79963	1.0	EA
TP9	210724	TERMINAL,QCK CLP,PC,MALE	835	79963	1.0	EA
TP10	210724	TERMINAL,QCK CLP,PC,MALE	835	79963	1.0	EA
U1	360428	IC,ANALOG MULTIPLIER	MPY100BG	13919	1.0	EA
U2	360530	IC,OP-AMP,FET,DUAL	UPC812	33297	1.0	EA
U3	360530	IC,OP-AMP,FET,DUAL	UPC812	33297	1.0	EA
U4	360530	IC,OP-AMP,FET,DUAL	UPC812	33297	1.0	EA
U5	360429	IC,MOS,ANALOG MULT. DUAL	CD4052BCN	86684	1.0	EA
U6	360530	IC,OP-AMP,FET,DUAL	UPC812	33297	1.0	EA
U7	360530	IC,OP-AMP,FET,DUAL	UPC812	33297	1.0	EA
U8	360506	IC,ANA,SWITCH,QUAD	IH6108CPE	32293	1.0	EA
VR1	360268	IC,VOLTAGE REG,+15,.1A	MC78L15ACP	04713	1.0	EA
VR2	360269	IC,VOLTAGE REG,-15,.1A	MC79L15ACP	04713	1.0	EA
VR3	360430	IC,VOLTAGE REG,-5,.1A	MC79L05ACP	04713	1.0	EA
Z1	360458	RES,ARRAY,TFLM,DIP,10K	698-3-10K-F	73138	1.0	EA
Z2	360458	RES,ARRAY,TFLM,DIP,10K	698-3-10K-F	73138	1.0	EA
Z3	360326	RES,ARRAY,SIP,100K	108A104	73138	1.0	EA
Z4	360326	RES,ARRAY,SIP,100K	108A104	73138	1.0	EA
Z5	360206	RES,ARRAY,SIP,100K	108B104	01121	1.0	EA
1	4000-769-1	PWB,METER/SERVO	4000-769-1	16067	1.0	EA

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Revision K
June 17, 1986

ONE YEAR WARRANTY

CALIFORNIA INSTRUMENTS, Division of Amstar Technical Products Co., Inc., warrants each instrument manufactured by them to be free from defects in material and workmanship for a period of one year from the date of shipment to the original purchaser. Excepted from this warranty are tubes, fuses, and batteries which carry the warranty of their original manufacturer where applicable. CALIFORNIA INSTRUMENTS will service, replace, or adjust any defective part or parts, free of charge, when the instrument is returned freight prepaid, and when examination reveals that the fault has not occurred because of misuse, abnormal conditions of operation, user modification, or attempted user repair. Equipment repaired beyond the effective date of warranty or when abnormal usage has occurred will be charged at applicable rates. CALIFORNIA INSTRUMENTS will submit an estimate for such charges before commencing repair, if so requested.

PROCEDURE FOR SERVICE

If a fault develops, notify CALIFORNIA INSTRUMENTS or its local representative, giving full details of the difficulty, and including the model number and serial number. On receipt of this information, service data or a Return Material Authorization (RMA) number will be given. Fill in RMA No. blank on shipping label attached opposite these instructions, pack instrument carefully to prevent transportation damage, affix label to shipping container, and ship freight prepaid to the factory. CALIFORNIA INSTRUMENTS shall not be responsible for repair of damage due to improper handling or packing. Instruments returned without RMA No., or freight collect will be refused. Instruments repaired under Warranty will be returned by prepaid surface freight. Instruments repaired outside the Warranty period will be returned freight collect, F.O.B. CALIFORNIA INSTRUMENTS, San Diego, CA. If requested, an estimate of repair charges will be made before work begins on repairs not covered by the Warranty.

DAMAGE IN TRANSIT

The instrument should be tested as soon as it is received. If it fails to operate properly, or is damaged in any way, a claim should be filed immediately with the carrier. A full report of the damage should be obtained by the claim agent, and a copy of this report should be forwarded to us. CALIFORNIA INSTRUMENTS will prepare an estimate of repair cost, and repair the instrument when authorized by the claim agent. Please include model number and serial number when referring to the instrument.

